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Barriers of knowledge transfer

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Abstract

The knowledge generated in universities and other public research institutions may contribute in many ways to technological change and innovation in the private sector (Grimpe and Fier 2009:1). However, especially in Europe seems to be a gap between outstanding scientific achievements on the one hand, and industry's competitiveness on the other side that is described in the literature as 'European paradox' (European Commission 1995:14).
Although the lack of effectiveness or lack of success of knowledge transfer in various regions, countries, industries or forms of cooperation is noted and chosen in a variety of studies as a starting point, the question of transfer barriers, their impact in the process of knowledge transfer so far has not been of central interest in economic research. If any, barriers of knowledge transfer are mentioned only summarily. The aim of this paper is to contribute towards closing this research gap by highlighting all those factors that prevent the transfer of knowledge with special focus on firm size. Although the issue transfer barriers so far has hardly been noticed, the many aspects of knowledge transfer discussed in the literature allow developing transfer barriers on empirical and theoretical foundation: empirical studies will reveal to problems of transfer, while theoretical works from different fields of knowledge will help to provide approaches for explanations and analysis.

Jelcodes:O33,O31

Barriers of knowledge transfer

1. Motivation

The knowledge generated in universities and other public research institutions may contribute in many ways to technological change and innovation in the private sector (Grimpe and Fier 2009:1). However, especially in Europe seems to be a gap between outstanding scientific achievements on the one hand, and industry's competitiveness on the other side that is described in the literature as 'European paradox' (European Commission 1995:14).

Although the lack of effectiveness or lack of success of knowledge transfer in various regions, countries, industries or forms of cooperation is noted and chosen in a variety of studies as a starting point, the question of transfer barriers, their impact in the process of knowledge transfer so far has not been of central interest in economic research. If any, barriers of knowledge transfer are mentioned only summarily. Gibson and Niwa (1991) for example mention "professional, technological, strategic, distance, competitive and cultural barriers" (p.503). Somewhat more concrete Irwin and More (1991) list seven transfer barriers between universities and companies without explaining them in more detail or analyzing the barriers in their effect: (1) highly specialized vocabulary, (2) diverging reward and incentive systems, (3) diverging motivations (publication vs. secrecy request), (4) diverging organizational forms and cultures, (5) different procedures for licensing and contracts, (5) inadequate technical conditions for the use of technology and finally, (7) insufficient financial resources for R&D related to the transfer of the technology available (p. 276).

The aim of this paper is to contribute towards closing this research gap by highlighting all those factors that prevent the transfer of knowledge with special focus on firm size. Although the issue transfer barriers so far has hardly been noticed, the many aspects of knowledge transfer discussed in the literature allow developing transfer barriers on empirical and theoretical foundation: empirical studies will reveal to problems of transfer, while theoretical works from different fields of knowledge will help to provide approaches for explanations and analysis. Starting point of the analysis is the interactive-recursive model of knowledge transfer described briefly in the following section.[1] Due to the complexity of knowledge barriers this paper deals only with the first dimension of knowledge transfer: the dimension of knowledge generation. Barriers with regard to the dimensions knowledge dissemination and knowledge absorption are subject of following works within this context.

[1] For a detailed derivation of the model see Eckl (2011, 2012).

2. Threoretical Framework: the Interactive-Recursive Model of Knowledge Transfer

While early models of technology and knowledge transfer are based on a uni-linear transfer concept, in which the knowledge-taker plays a mostly passive role (Wahab et al. 2009), recent knowledge-based business theories and models of organizational learning emphasize the importance of active participation of the knowledge-taker[2]. For Tiemessen et al. (1997) knowledge transfer is "to accept the partner's knowledge, to integrate knowledge into one's own system or changing one's own resources to imitate knowledge" (Tiemessen et al. 1997, cited in Wahab 2009:560).

Fundamental dimensions of knowledge transfer

The identification and analysis of barriers in the process of knowledge transfer requires a comprehensive concept of knowledge transfer to not obstruct the view of potential transfer barriers a priori. Knowledge transfer is understood here as a complex interactive, non-linear and possible recursive process, which - according to the stage model by Gibson and co-authors (1990, 1991, 1994) - has three basic dimensions[3]:

- *knowledge generation* (defined by the process of topic selection, project selection and project implementation),
- *knowledge diffusion* (defined by the process of preparation and dissemination of knowledge) and
- *knowledge absorption* (defined by the process of assessment, assimilation and application of knowledge).

The concept of knowledge transfer is therefore not regarded merely as a link between existing knowledge and its application, but encloses constitutively the generation of knowledge and its absorption by the knowledge-taker. The establishment of three fundamental dimensions of knowledge transfer expresses the process-related character of knowledge transfer. This should not be thought of as a unidirectional sequence, but must be understood non-linear and potential recursively, because he has neither a real beginning nor real ending. Knowledge transfer is understood as a continuous, never-ending process, in which a new spiral of knowledge transfer can be set in motion at any point, and in which the direction of the process can be turned the other way around at any point.[4]

Knowledge Transfer Actors

The motives and resulting actions of the actors are of crucial importance for the analysis of knowledge transfer processes and potential barriers. Actors can be summarized in three groups with changing intersections of stakeholders (employees of public research institutes and companies):

- *knowledge-creators*: those who are actively involved in the creation of knowledge. In the model it represents the group of actors in the dimension of knowledge creation.

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[2] In this paper the term ‘knowledge taker’ instead of the still pre-dominant ‘knowledge receiver' is chosen. In contrast to the rather passive term ‘receiver’, the concept of 'taker' emphasizes the active idea of the process and fits therefore more adequate to the current state of the understanding of knowledge transfer as an interactive process.

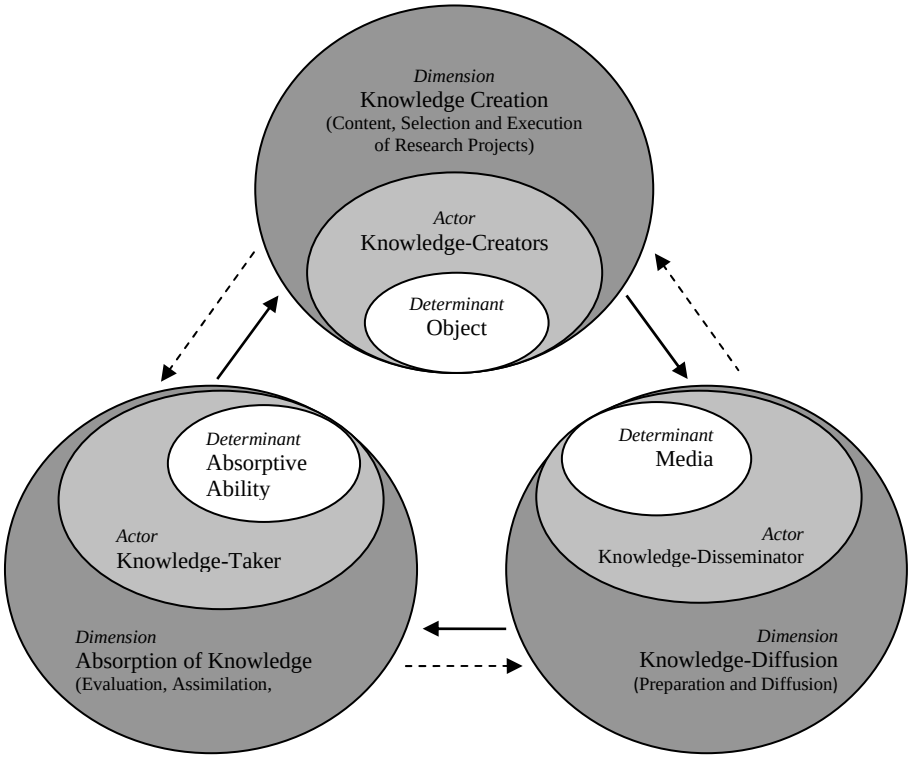
[3] The notion dimension is used here in reference to its use in mathematics, where it essentially indicates the degrees of freedom of movement in a particular area. Each of the three dimensions is understood as an integral part of the knowledge transfer process (motion), within the scope of possible design (degree of freedom) by the actors in relation to certain determinants of knowledge transfer (space) is determined.

[4] This view of the knowledge transfer process as a never-ending, spirally developing process corresponds to the process of knowledge generation, particularly outlined by Nonaka and co-authors.

- *knowledge-disseminators*: those who are actively involved in the dissemination process of knowledge. In the model it represents the group of actors in the dimension of knowledge dissemination.
- *knowledge-takers*: those who accept and absorb the generated and disseminated knowledge. In the model it represents the group of actors in the dimension of knowledge absorption.

The aspect of interaction in the process of knowledge transfer is therefore integrated in the form of groups of actors. The output or the results of their actions in each of the dimensions produce the determinants of knowledge transfer, which are in the center of attention within the analysis of transfer processes. Motives and resulting actions of the players are crucial for the analysis of knowledge transfer processes within each dimension for the configuration of the determinants. Individual groups of actors such as private or public institutions and organizations, research institutes and companies are therefore not analyzed separately, but always in conjunction with all other stakeholders of significant importance within the same dimension.

Figure 1: An interactive-recursive model of knowledge transfer



Notes: Own illustration

Determinants of Knowledge-Transfer

The nature of knowledge transfer determinants is of vital importance for the analysis of knowledge transfer processes and potential barriers. Since formed within each of the three basic dimensions, a differentiation of the knowledge transfer process in three dimensions is due primarily analytical considerations. Determinants of knowledge transfer are defined as:

- *transfer-object* in the context of the dimension of knowledge creation,
- *transfer-media* in the context of the dimension of knowledge dissemination, and

- *absorptive ability* of the knowledge-taker in the context of the dimension of knowledge absorption.

Object, media and absorptive ability are called determinants because its characteristics are decisive for the success of knowledge transfer.

The central interest of this study is the existence of barriers within knowledge transfer in the first dimension of knowledge transfer: *knowledge generation*. Barriers are understood as all those factors which prevent the process of transfer of knowledge from working.

3. Barriers of knowledge transfer with respect to relevance of research results

The interactive-recursive model of knowledge transfer can serve as a basis for the identification and analysis of potential transfer barriers. Based on the assumptions that (1) research projects lead to positive results respectively solutions are found for previously defined problems, and that (2) the existence of these solutions are known to a circle of potential knowledge-takers, barriers of knowledge transfer - including the perspective of SME – may happen basically in two ways: Either (1) the potential for knowledge is not or not sufficiently relevant to the knowledge-taker or (2) it is indeed relevant, but the knowledge-takers are not able to absorb the knowledge. The latter may be caused by the fact that (a) the results are not available or only available in inadequate manner, or that (b) the abilities of the potential knowledge-taker are not sufficient to evaluate, assimilate and apply the external knowledge. Possible transfer barriers associated with the relevance of externally generated knowledge are in the focus of the subsequent sections and concern (3.1.) the importance of participation in knowledge creation and (3.2.) the culture of the involved research institute.

3.1. The importance of participation in knowledge creation

Participation in the knowledge creation process is a decisive advantage with regard to the chances of subsequent knowledge application that cannot be compensated by participants using formal or informal transfer channels. The next section concentrates initially only on possibilities of influence on the relevance of the created knowledge. A participation in the dimension of knowledge creation causes additional benefits such as access to informal knowledge and improvement of own absorption abilities, which are discussed in the two subsequent sections of this chapter.

Due to the (inter-)active participation in the process of knowledge creation firms can exert influence on identification, selection and implementation of a research projects, not only to design the subject but also the scope and course of the project in accordance with their own business needs. From the beginning firms then have the opportunity to ensure the relevance of research results for the company.

Participation in joint-research projects is described in the literature as particularly successful. Adams et al. (2003) found in a statistical analysis of the contribution of public research for the research productivity of industrial enterprises that collective research projects are more likely to develop new technologies than other forms of business cooperation with public research institutions (p. 3).

According to Fritsch and Schwirten (1990) the contribution of public research institutions for the innovation process of private enterprises is particularly significant during knowledge creation through the development of new ideas (p.80). They attribute this to the fact that even scientists in public institutions closely follow new developments in their research fields (p.74).

Various studies show that companies have recognized the importance of participation in cooperative or interactive research projects, and "use this kind of research in addition to the transfer of staff most intensively in order to acquire the knowledge produced at public research institutions" (Czarnitzki et

al. 2000:19). This result correlates with the findings of Staudt and Krause (1999), which center the cooperation of the "provider" and "demand side" of knowledge for successful knowledge transfer: "The distribution of tasks between the various transfer partners in the innovation system on the one hand and personal contact on the other hand are the most important parts of transfer efforts"(p. 60 f.). Significant in this context is the embeddedness in information networks, through which companies already benefit from the joint knowledge creation by profiting from the insights and experiences of other stakeholders (Senker und Faulkner 1996:87).

The importance of participation in collaborative research for the innovation process of companies is particularly evident if it is a question of research collaborations, where the company is involved in the process of knowledge creation either as knowledge-taker, as research-demander or as participant in joint research projects. This situation is different for pre-competitive research. Although there are companies involved in the generation of research results, the transfer just as well to non-participating companies is an explicit target of the public funding agency. Pre-competitive research therefore breeds firstly the question of companies' motivation to participate in the implementation of projects while the results should in principle be freely accessible to all. Thus, pre-competitive research with the aim of the widest possible diffusion of research results leads to the creation of public goods. Such goods are characterized firstly by the fact that nobody will be excluded from the consumption or absorption ("non-excludability"). The second characteristic is that by the use of a company the benefit of another company is not be reduced ("non-triviality") (Donges and Freytag 2004:163, Voigt 2002:118).

To illustrate the characteristics of public goods Voigt (2002:118) gives the example of a dike that protects all local people behind it from flooding, regardless of whether they were involved in its building or not. Simultaneously, the level of protection is not affected by the number of people behind the dike. This phenomenon is also known under the term positive externalities, that refers to such consequences of decisions affecting the economic activities of those positive who are not involved in the actual decision-making (Cherry 2004:168). The problem is described in the literature as a "free-rider-dilemma" (see Donges and Freytag 2004:163). In the case of pre-competitive research, this means that companies benefit of research outcomes, without being involved in their generation.

The disadvantaged one within the free-rider-dilemma is always the one who first revealed his preferences and undertakes the production and financing of public goods on his own. Assuming a rational behavior of both companies pre-competitive research with the result of creating a public good would possibly be avoided:

> "Since both individuals may figure out this connection it is not impossible that both will hold back; with the result that a need satisfaction, in which both have an interest, remains" (Kirsch 2004:169).

Yet some companies take money, time and effort to participate in pre-competitive knowledge generation and therefore in the provision of public goods through collective action. It can therefore be assumed, that opportunities exist to solve the free-rider-dilemma by providing incentives for research participation.

Based on the theory of interest groups by Olson (1965, 2004) it can be shown that incentives to participation in the generation of scientific knowledge as a public good can lead to a barrier of knowledge transfer. The theory of interest groups is part of the New Political Economy (NPE), which is characterized by accepting methodological individualism of the neoclassical theory as the fundament of political decision-making processes, in which the rational individual is guided by self-interest and tries to maximize its benefits. According to Olson, the willingness of individuals to participate in groups depends on the expected benefits and costs. The costs of participation may be membership fees, donations, and also invested time, while the benefits result from distribution profits of interest articulation within the group.

In his remarks on the organizability of interests in different groups Olson (2004) distinguishes between large and small groups. Both groups comprise different ways of incentive-setting to participate in the creation of collective goods. An incentive to participate in the generation of knowledge consists in the formation of a small group within the large group of potentially interested companies.[5] In contrast to large groups, small groups can aim at homogeneous targets, because the individual contribution achieves high priority. In addition, there are low prospects to realize benefits without sharing expenses because of the low cost of social control. Accordingly high is the incentive of participation in small groups with matching goals. Small groups are therefore easier organizable than large groups. Thus small groups are better suited to enforce their interests against third parties. Therefore, according to Olson political decisions are biased in favor of small groups while it is the large or "forgotten" groups that "suffer in silence" (Olson 2004:163).[6]

In relation to knowledge transfer it is a small group of companies that are actively involved in the generation of knowledge and achieve advantages by participating in topic definition, selection and implementation of the research object in such a manner that this is primarily relevant for their own needs. Overall, it is plausible that the small group participating at the inter-active process of knowledge generation benefits in a particular way. The formation of a small group as an incentive to solve the above-discussed free-rider problem causes - regardless of company size represented in the small group of companies - the possibility of a transfer barrier in itself, because it may oppose a broad transfer of research results as a public good to non-participating companies.

A particular problem from the perspective of SME with regard to participation in the generation of knowledge can arise if the small group of companies involved mainly consists of large enterprises (LE). LE can also form a small group in the process of knowledge creation whose interests are not necessarily congruent with the research desiderata of SME. Depending on the industry structure the proportions of LE and SME indeed differ, but one may say in almost all sectors, that they are characterized by either just few LE or few LE and many SME. LE consequently form a small group within their industrial sector. Based on this consideration, two questions arise in relation to participation in knowledge generation and the resulting potential transfer barriers in particular for SME: Participate LE more frequently in the process of knowledge creation and, if so, raises that a barrier of knowledge transfer to SME? Both issues will be discussed below.

Do large enterprises (LE) participate more frequent in the process of knowledge creation?

Size and standing of company-internal R&D departments has decisive influence on participation in research collaborations, and therefore also on participation in the process of knowledge generation. Beise and Stahl (1999:409) note: "The more firms are committed to their own R&D activities, the more they use external knowledge". Additional R&D efforts are usually needed for the absorption of external knowledge (Bloedon and Stokes 1994:44). The importance of company-internal R&D activities in particular become evident in the context of pre-competitive collaborative research, because "the project results generally must be further developed by individual companies and transferred into applicable product and process components " (Welter 1995:49).

SME are not inherently less innovative than LE. The relationship between size and innovation performance is not necessarily causal in nature, as Beise and Stahl (1999:409) point out:

[5] Incentive-setting for large groups and the resulting barriers to the transfer of knowledge will be discussed later in this section.

[6] Small groups are certainly easier to organize and can therefore assert their interests more effectively, but this is not equivalent with the fact that they are also more efficient (Becker 1983:395).

> "The size of the firm includes many factors determining its behaviour. Size is rather a proxy for factors that correlate with size than the explaining variable itself. It is a proxy for scale effects of knowledge production, the capacity to specialise functions and to perform applied research as well."

Financially and personally well-equipped R&D departments, however - apart from some exceptions – are generally maintained primarily by LE. This is one of the reasons why research partnerships and relationships with public research institutions are of secondary importance for the innovation process of SME compared to relationships with customer and competitors (Lageman 2001:424, see also Lageman et al. 1999:207).

Consequential LE participate more frequently in the creation of knowledge than SME as a number of studies shows. Roessner and Bean (1991, 1994) and Papadakis (1992) found a correlation between financial resources and personnel strength of a company and its cooperation with public research institutions. This result is corroborated by an empirical analysis of the innovation behavior of German entrepreneurs by Kamp and Römer (1998). They show that with the company's size increases investment efforts, patent and utility model applications and innovation. This finding correlates with the results of the study of Beise and Stahl (1999:409) and is confirmed by Kaufmann and Tödtling (1999:80), which deal specifically with public funding and its impact on SME. This finding is also substantiated in a study by Cohen et al. (2002) on the influence of public research on industrial R&D in the U.S. manufacturing sector: Again, primarily LE use the results of public research (p.1 f).[7]

Size and standing of company-internal R&D departments is an important, but not the only factor that is important with view to participating in research collaborations. In the literature there are various approaches to explain why SME participate less in research collaborations than LE. Welter (2003) has pointed out that the management in SME in general is not characterized by medium-or long-term strategic considerations, as it constitutes participation in a research collaboration: "Many empirically observable strategy patterns in SME are assigned to the category of shorter-term strategies " (Welter 2003:44). In addition, the higher risk for SME, to lose their specialized knowledge during co-operations with fellow competitors in the field of LE may discourage participation in joint research projects (Hagedoorn et al. 2008:533).

Rothwell and Dodgson (1991) attribute the relatively lower participation of SME in the process of knowledge generation to limited management capacity and resources. High opportunity costs, bureaucracy and possible problems in the protection of patents and property rights are therefore responsible for not entering into collaborations with LE (p. 135). This resource based argument is confirmed in a study of 208 Belgian SME by Lybaert (1998). In her study she analyses the relationship between the use of external information and characteristics of business leaders. Due to the reduced resources, it is disproportionate more difficult for SME managers to get even an impression of possible research collaborations. Limited resources lead not only to the fact that SME decide against research collaborations, but are responsible for the fact that not enough information can be collected to decide in favor or against a participation (p.188).

Other considerations explaining the increased role of LE in research collaborations are related to the motivation to participate in research collaborations. It is controversial in the literature to what extent the interest in specific research results plays a role as a motif of participation. Bozeman (2000) e.g. refers to the interest in research results to be of secondary importance (p. 642). A study by Geisler and Clements (1995) concluded that companies are generally more interested in technical expertise and, resources of the partners, as in the development of specific products or licenses. Hagedoorn et al.

[7] The only exception to the rule that LE benefit intensified of public research are small, technology-based businesses (Lynskey 2010:30).

(2000) see the main motivation in the access to complementary external research (p.579). Studies on pre-competitive research programs in Germany and the UK come to a similar result: the large majority of participating companies referred to the acquisition of complementary expertise as a motivation for their participation in the program (Welter 1995:50, Quintas and Guy 1995:339).

The interest in the specific outcome of research projects should be in principle one of the most important motives for participation in a research collaboration (Cohen et al. 2002:18). Within the analysis of the 1999 launched German program PRO INNO more than half of the interviewed SME mentioned the lack of know-how within the company and almost three quarters of companies referred to the specific problem-solving expertise of external partners as a reason for entering into a research collaborations (Prognos 2002:5).

Regardless of the weighting of individual motivations, there is consensus that interest in the results of community research is only one of several aspects to induce company's participation. In the literature a number of other entrepreneurial motives are known. Geisler and Rubenstein (1989) explore, based on a study of 400 collaborations between universities and companies in twelve major themes: access to students and professors, access to technology for solutions, outsourcing of R&D activities, prestige and access to current ‚state-of-the-art' information (see also Hagedoorn et al. 2000:579 as well as Balconi and Laboranti 2006:1619). To what extent these benefits can be used, is again a question of company's own resources and capacities, so that the mentioned motivations for participation in joint research may be higher for LE than for SME.

Does the dominance of LE within the knowledge creation process result in a transfer barrier for SME?

The distinctive involvement of LE in collaborative research does not necessarily result in a barrier of knowledge transfer with the consequence of an economic disadvantage for SME. Welter (1995) concludes in their study of the German Industrial Collective Research Program (ICR) that "the presence of large firms in the committees will not result in dominance over SME and their research endeavors" (Welter, 1995:52). The companies surveyed were positive about the mixing ratio, which usually correspond to the relationships between LE and SME within the work-sharing process.

Similarly Fischer (2006:122) points out that especially SME rely on learning and knowledge transfer through the co-operation with customers and suppliers due to limited own capacities for carrying out internal R&D. Even if research contents are tailored in a special way on the specific interests of LE, SME can still benefit from participation because of the contact to other companies (suppliers and customers but also competitors) involved in the knowledge creation process. Participation in research collaborations offers SME the opportunity not only to forge informally contacts with potential customers and to emphasize their own skills and products. It also opens up the possibility of learning effects and the formation of so-called 'learning alliances' through personal contacts and interactions between the companies (Welter 1995:54).

The complementary nature of collective research of LE and SME is also emphasized by Rothwell and Dodgson (1991, 1996), in particular if it comes to high-tech start-ups (Rothwell and Dodgson 1996:323). SME can use their 'large' customers as the main source for new technologies because LE want to see certain technological requirements for their products implemented at the supplier-level. At the same time, the customer communicates his experiences with the use of the supplied products and resulting improvement suggestions. In addition, LE use SME also as windows for the development of new technologies, especially in the case of small, high specialized engineering and development companies, often university spin-offs in the field of new technologies. Altogether there are growing technological exchanges between customers and suppliers throughout the manufacturing industry (Rothwell and Dodgson 1991, 1996).

In summary, it can be stated that a dominance of LE in the knowledge creation process does not necessarily result in little relevance of the transfer object for SME, since SME benefit of their incorporation in value chains with LE also if the research is targeted primarily to the needs of LE. Conversely the dominance of LE might become a barrier of knowledge transfer to SME if this integration into value chains is not given.

3.2. The culture of the research institution as a barrier

A significant branch of the innovation literature focuses on the question of the impact of organizational culture on knowledge transfer within science-industry collaborations.[8] Mostly, these are empirical works to examine e.g. the impact of personal contact between academic researchers and companies on the commercial success of scientists and the degree of application of research. Following these studies, a collaboration of research institutions with industry generally shows a positive impact on marketability and applicability of research results generated by the companies involved in the generation of knowledge (Bozeman 2000:639).

The culture of a research institution concerning its cooperation with industry is an important aspect in regard to the relevance of research and possibly resulting barriers for a broad transfer of knowledge, especially in the context of pre-competitive research, in which results developed in cooperation of science and industry should be transferred also to companies who were not involved in the process of knowledge creation.

According to Sporn (1996:45) the culture of the research centre is defined as individual and collective values, attitudes and objectives of the research staff or the organization and the resulting behaviors and institutional arrangements with regard to the collaboration with industry and the economic exploitation of their research results. The research institution takes an active influence on the course of the project and is decisively responsible for the results of their R&D efforts. But scientists entrusted with the project are pursuing different goals. For one, an academic qualification work, usually a doctorate can be connected to the project. On the other hand, the project engineers can signal their academic skills to the participating companies to target a position in the company after or even during the project (Adams et al. 2001:73).

A survey-based study of natural science and engineering research units at public research institutions in Germany considers the characteristics of the knowledge creator as a cause for "limits of knowledge and technology transfer"[9] (Czarnitzki et al. 2000:29). A different teaching orientation, the organizational and legal framework, basic decisions on research policy and the function assigned by the public sector in the research landscape are named as factors in this context (Czarnitzki et al. 2000:29). In this study, above all, the content specialization and the type of institution financing are of crucial importance for the level of interaction between research institutions with enterprises:

> "Those institutions that conduct research in application-oriented and business-related fields, being oriented in their external financing sources outside of state funding [...], show a significantly higher level of interaction with industry as basic research oriented institutions with financing heavily based on public funding [...] or institutions oriented strongly on education and training." (Czarnitzki et al. 2000:38)

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[8] Rosenberg and Nelson (1994), Hounshell (1996) and Hackett (2001) offer a historical overview of studies that deal with research collaborations between public research institutions and industry.

[9] These limits are not understood in relation to the transfer of knowledge as such but only as inhibiting factors for science-industry links (i.e. part of the knowledge generating process).

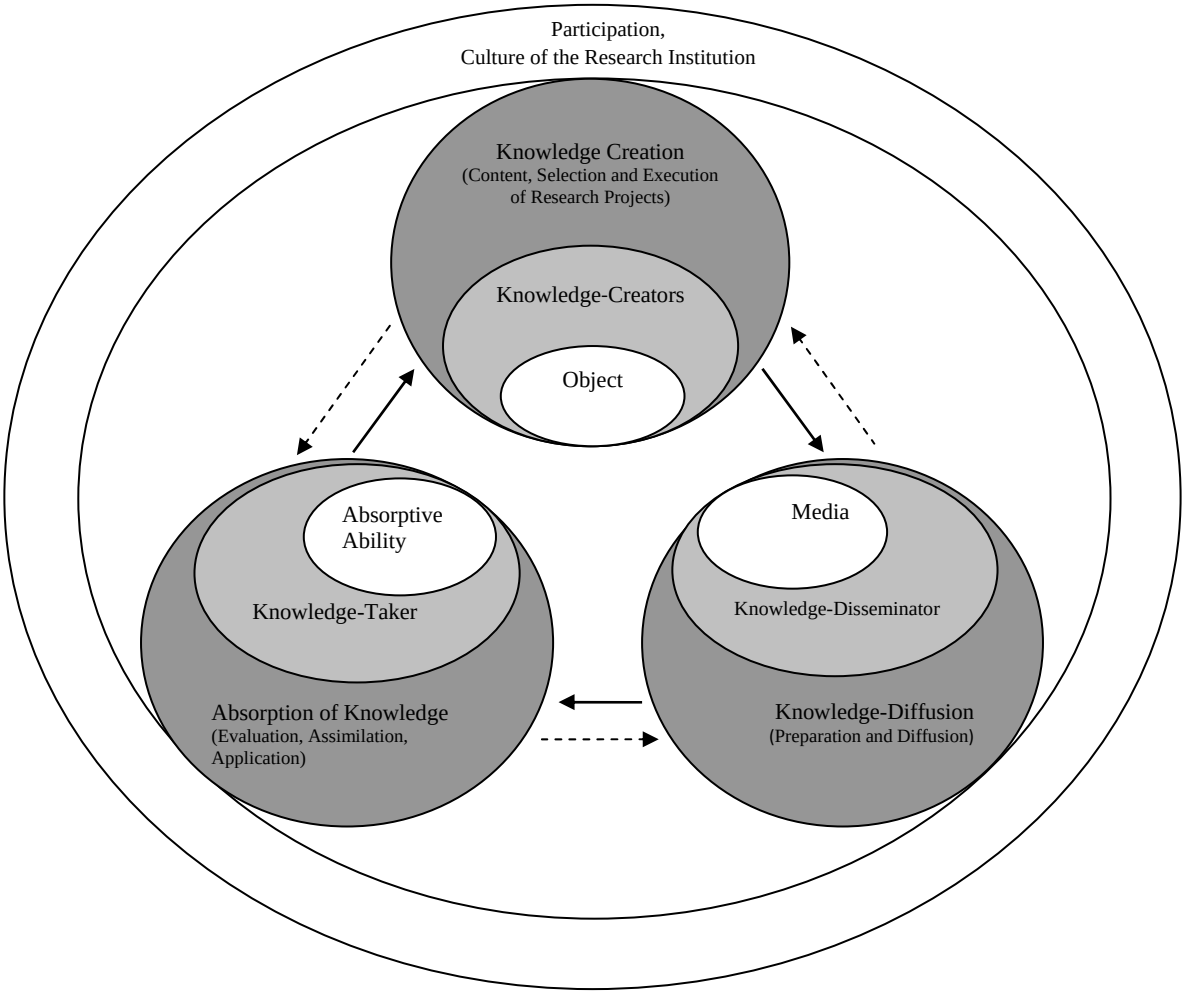
The culture of the research institution, due to content specialization and type of institutional funding poses the potential for conflict facing the objectives and expectations of industry in a research collaboration also matters within the knowledge creation process.

In their study of U.S. Industry-University Cooperative Research Centers (IUCRCs) Cohen et al. (1998) conclude that conflicts emerge within the academic functioning, as the research is too much application-oriented and leads to a lack in time for scientific exploitation. A lack of practical relevance in academic research may be one of the reasons why SME - with the exception of SME in knowledge-intensive sectors - cooperate less with academic institutions as research partners (Veugelers and Cassiman 2005:373) and are more likely to fall back on universities of applied sciences and private research institutes, as those take a higher applied approach considering their research (Czarnitzki et al. 2000:15).

4. Conclusion and Implications

The aim of this paper was to contribute towards closing this research gap by highlighting all those factors that prevent the transfer of knowledge with special focus on firm size. Starting point of the analysis was the interactive-recursive model of knowledge transfer. Due to the complexity of knowledge barriers the paper dealt only with the first dimension of knowledge transfer: the dimension of knowledge generation (Figure 2).

Figure 2: Barriers of Knowledge Transfer - Relevance



Source: Eckl 2011, p. 120.

As a result transfer barriers associated with the relevance of externally generated knowledge occur due to the participation constellation within the process of knowledge generation as well as due to the culture of the involved research institute. The free rider dilemma of public research and pre-competitive research collaboration may result in barriers of knowledge transfer if the knowledge-generator is not willing to transfer the knowledge because of already occurred costs or lacking benefits. A dominance of large enterprises (LE) in the knowledge creation process does not necessarily result in little relevance of the transfer object for SME but might become a barrier of knowledge transfer if SME's integration into value chains is not given. The culture of the research institution, due to content specialization and type of institutional funding poses the potential for conflict facing the objectives and expectations of industry in a research collaboration.

Barriers with regard to the dimensions knowledge dissemination and knowledge absorption are subject of subsequent works within this context. An empirical testing of the model and its components is also part of future works.

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